	Application No.	Applicant(s)
Notice of Allowability	10/700,991	TAROKH ET AL.
	Examiner	Art Unit	
	Dung Lam	2687	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *11/04/05*.

2. ☒ The allowed claim(s) is/are *1, 9, 10,11,16,17, 19-36, 39-41,49-51, 56, 57 and 59-80* .

3. ☐ The drawings filed on _____ are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a) ☐ All   b) ☐ Some*   c) ☐ None of the:

       1. ☐ Certified copies of the priority documents have been received.

       2. ☐ Certified copies of the priority documents have been received in Application No. _____ .

       3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

    * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

    (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached

       1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.

    (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of

      Paper No./Mail Date _____.

    Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)

2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)

3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____

4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

5. ☐ Notice of Informal Patent Application (PTO-152)

6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .

7. ☒ Examiner's Amendment/Comment

8. ☐ Examiner's Statement of Reasons for Allowance

9. ☐ Other _____ .

EXAMINER'S AMENDMENT

1.   An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

2.   Authorization for this examiner's amendment was given in a telephone interview with David Morasch on 12/22/05.

The application has been amended as follows:

3.   The uppercase letter c in the word "Claim" should be replaced by lower case c -- claim -- for all of the following claims.

       Claim 9, 11, 19, 20-40

       Claim 10, line 14

       Claim 11, line 18

       Claim 19, line 21

       Claim 20, line 1

       Claim 21, line 4

       Claim 22, line 8

       Claim 23, line 11

       Claim 24, line 5

       Claim 25, line 19

       Claim 26, line 1

       Claim 27, line 6

       Claim 28, line 10

       Claim 29, line 14

       Claim 30, line 18

       Claim 31, line 22

Claim 32, line 2

Claim 33, line 7

Claim 36, line 1

Claim 37, line 7

Claim 38, line 11

Claim 39, line 18

Claim 40, line 2

Claim 26, line 1

Claim 50, line 11

Claim 51, line 15

Claim 56, line 1

Claim 57, line 7

Claim 59, line 21

Claim 60, line 1

Claim 61, line 5

Claim 62, line 10

Claim 63, line 14

Claim 64, line 18

Claim 65, line 1

Claim 66, line 6

Claim 67, line 12

Claim 68, line 16

Claim 69, line 20

Claim 70, line 1

Claim 71, line 5

Claim 72, line 9

Claim 73, line 12

Claim 74, line 1

Claim 75, line 16

Claim 76, line 20

Claim 77, line 2

Claim 78, line 6

Claim 79, line 13

Claim 80, line 19

4.   **Claim 9** has been replaced as:

Claim 9. A method for use in a wireless communication system, the method comprising:

outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal being operatively configured to cause said smart antenna to perform subspace complementary beam forming (SCBF), and said at least one signal including N-K data streams operatively configured to caused said smart antenna to transmit energy in at least one side lobe

determining said at least one signal by using a Downlink Beamforming Matrix: $W = UAV^H$.

determining said at least one signal by using a Steering Matrix: $A = [a(\theta_1)\ a(\theta_2)\ \ldots\ a(\theta_K)]$, wherein $a(\theta_k)$ represents a steering vector of user k.

wherein

if $W = A^*B$, where B is a non-singular K-by-K matrix, then using a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}} \; [u_{K+1} \; u_{K+2} \cdots u_N]$$

wherein $C_0 = N_{C_0}$ is the level of the main lobe, k_0 is the scaling factor and u_l is the l-th column vector of U.

otherwise using a complementary beamforming matrix of

$$W^c = \sqrt{\frac{k_0 C_0}{N}} \; [u_1 \; u_2 \cdots u_{N-K}]$$

wherein $\bar{u}_l$ is the l-th left singular vector of the matrix

$$\left(\sum_{l=K-1}^{N} a_l a_l^H \right) U \Lambda^c = \bar{U} \bar{\Lambda} \bar{V}^H ,$$

and $A^c = \bar{U} \bar{\Lambda} \bar{V}^H$ is assumed, and in scattering channel $H^c = \bar{U} \bar{\Lambda} \bar{V}^H$ is assumed.

5. **Claims 13-15** have been canceled.

6. **Claim 17** has been replaced as:

Claim 17. A method for use in a wireless communication system, the method comprising:

outputting at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal is operatively configured to cause said smart antenna to perform complementary superposition beam forming (CSBF)

determining said at least one signal by using a downlink beamforming matrix $W = [w_1 \ldots w_{k-1} \; \tilde{w}_k \; w_{k+1} \ldots w_L]$, where $\tilde{w}_k = p_0 w_k + W^c p$ and p is complex conjugate transpose of the l-th row of W^c,

$$p_0 = \frac{w_{k,l}^*}{|w_{k,l}|}$$

is normalized complex conjugate of the l-th element of w_k.

7.   **Claim 18** has been canceled.

8.   **Claim 49** has been replaced as:

Claim 49. An apparatus for use in a wireless communication system, the apparatus comprising:

circuitry configured to output at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal is operatively configured to cause said smart antenna to perform subspace complementary beam forming (CSBF). And said at least one signal including N-K data streams operatively configured to cause said smart antenna to transmit energy in at least one side lobe

wherein said

circuitry is configured to determine said at least one signal by using a Downlink Beamforming Matrix: $W = UAV^H$.

wherein said

circuitry is configured to determine said at least one signal by using a Steering Matrix: $A = [a(\theta_1) \; a(\theta_2) \; . \; . \; . \; a(\theta_K)]$, wherein $a(\theta_k)$ represents a steering vector of user k.

wherein

if $W = A^{\cdot}B$, where B is a non-singular K-by-K matrix, then said circuitry is configured to use a complementary beamforming matrix of

$$W^{c} = \sqrt{\frac{k_0 C_2}{N}} \left[u_{K-1} \quad u_{K-1} \quad \ldots \quad u_N \right]$$

wherein $C_2 = N_{C_0}$ is the level of the main lobe, k_0 is the scaling factor and u_i is the l-th column vector of U,

otherwise said circuitry is configured to use a complementary beamforming matrix of

$$W^{c} = \sqrt{\frac{k_0 C_2}{N}} \left[\bar{u}_1 \quad \bar{u}_2 \quad \ldots \quad \bar{u}_{N-K} \right]$$

wherein $\bar{u}_i$ is the l-th left singular vector of the matrix

$$\left(\sum_{l=K+1}^{N} a_l a_l^{H} \right) U \Lambda^{2} = \bar{U} \bar{\Lambda} \bar{V}^{H},$$

and $A^{\cdot} = \bar{U} \Lambda V^{H}$ is assumed, and in scattering channel $H^{\cdot} = \bar{U} \Lambda V^{H}$ is assumed.

9.　　**Claims 53-55** have been canceled.

10.　　**Claim 57** has been replaced as:

Claim 57. An apparatus for use in a wireless communication system, the apparatus comprising:

circuitry configured to output at least one signal suitable for causing a smart antenna to transmit at least one complementary beam, said at least one signal is operatively configured to cause said smart antenna to perform complementary superposition beamforming (CSBF)

wherein said

circuitry is configured to determine said at least one signal by using a downlink beamforming matrix: $W = [w_1 \ldots w_{k-1} \ \bar{w}_k \ w_{k+1} \ldots w_K]$, where $\bar{w}_k = p_0 w_k + W^{c} p$ and p is complex conjugate transpose of the l-th row of W^{c},

$$p_0 = \frac{w_{k,l}^{*}}{|w_{k,l}|}$$

is normalized complex conjugate of the l-th element of w_k.

11.　　Claim 58 has been canceled.

Response to Amendment

12.   The amendments, filed on 11/04/05, have been entered and made of record.

Allowable Subject Matter

13.   Claims 1, 9, 10,11,16,17, 19-36, 39-41,49-51, 56, 57 and 59-80 are allowed.

The examiner's reason for allowing the independent claims 1, 9, 17, 34, 41, 49, 57, 74

presented is based on Applicant's Remarks filed on 11/04/05 and the above examiner

amendments.

Regarding claims 32,33,39,40, 10,11,16, 19-31, 35-36, 72-73, 50,51,56, 59-71 and 75-80,

the claims are allowed as being dependent of claims 1, 9, 17, 34, 41, 49, 57 and 74, respectively.

Conclusion

14.   Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

15.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung Lam whose telephone number is 571-272-6497. The examiner can normally be reached on Monday - Friday   8AM - 5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lester Kincaid can be reached on 571-272-7922. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DL

12/22/05

SONNY TRINH
PRIMARY EXAMINER